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5 October 2000

Mr. Peter Hugh
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New England District
696 Virginia Road
Concord, MA 01742-2751

Work Order No. 20121001.095.1060

Re: Contract No. DACW33-00-D-0006, Task Order 0001
Final Addendum to the Engineering Evaluation/Cost Analysis for the Upper Reach of the Housatonic River
GE Housatonic River Project, Pittsfield, MA
DCN: GE-092800-AADP

Dear Mr. Hugh:

Roy F. Weston, Inc. (WESTON®) is pleased to provide three copies of the *Final Addendum to the Engineering Evaluation/Cost Analysis for the Upper Reach of the Housatonic River* for the General Electric (GE) Housatonic River Project in Pittsfield, MA. WESTON is also providing six copies to Chet Janowski at the EPA office in Boston, MA, and two copies to Susan Steenstrup at the MADEP office in Springfield, MA. One copy each is also being sent to Ray Goff (USACE), Margaret McDonough (EPA), HTRW Center of Expertise, EPA Pittsfield, each trustee, and each advisor. Twelve copies are being sent to Holly Inglis for distribution to the Information Repositories. Two copies are being sent to Chet Janowski for distribution to GE. Thirty-five copies of Sections 1 through 4 and the tables and figures are being sent to Chet Janowski for distribution to the Citizens Coordinating Council.

This submittal has undergone WESTON's technical and quality control review and coordination procedures to ensure: (1) completeness for each discipline commensurate with the level of effort required for the submittal; (2) elimination of conflicts, errors, and omissions; (3) compliance with the project criteria; and (4) overall professional and technical accuracy of the submittal.

Please feel free to contact Joel Lindsay at 603-656-5445 or me at 610-701-7366 if you have any questions.

Very truly yours,

ROY F. WESTON, INC.

Lee dePersia, P.E.
Project Manager

Enclosures
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U.S. Army Corps of Engineers

New England District
Concord, Massachusetts

FINAL

ADDENDUM TO THE ENGINEERING EVALUATION/COST ANALYSIS FOR THE UPPER REACH OF THE HOUSATONIC RIVER

DCN: GE-092800-AADP

4 October 2000

Environmental Remediation Contract
General Electric (GE)/Housatonic River Project
Pittsfield, Massachusetts

Contract No. DACW33-00-D-0006

Task Order No. 0001

00P-1640-1

WESTON
MANAGERS DESIGNERS/CONSULTANTS

FINAL
ADDENDUM TO
THE ENGINEERING EVALUATION/COST ANALYSIS
FOR THE UPPER REACH OF THE HOUSATONIC RIVER

ENVIRONMENTAL REMEDIATION CONTRACT (ERC)
GE/HOUSATONIC RIVER PROJECT
PITTSFIELD, MASSACHUSETTS

Contract No. DACW33-00-D-0006
Task Order No. 0001
DCN: GE-092800-AADP

Prepared for:

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Section 1
Introduction

1. INTRODUCTION

This Addendum to the Engineering Evaluation/Cost Analysis (EE/CA) for the Upper Reach of the Housatonic River presents the results of a supplemental investigation developed to address data gaps identified during preparation of the Final Draft EE/CA Report. The EE/CA addresses the 1½-mile reach of the Housatonic River located between Lyman Street and the confluence of the East and West Branches in Pittsfield, MA (hereinafter referred to as the "EE/CA Reach"). The Housatonic River site generally consists of the General Electric (GE) facility and the Upper ½-Mile Reach, the 1½-mile EE/CA Reach, and the remainder of the river beginning at the confluence of the East and West Branches. Based on the Consent Decree (the CD) (00-0388, 00-0389, 00-0390) lodged in Federal District Court on 7 October 1999, GE is performing removal activities at the GE facility and on the Upper ½-Mile Reach, whereas EPA is performing and partially funding the removal activities on the EE/CA Reach. Figure 1-1 depicts the location of the EE/CA Reach of the Housatonic River in Pittsfield. The hazardous substances associated with the EE/CA Reach include polychlorinated biphenyls (PCBs), dioxins, furans, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic constituents.

The Final Draft Engineering Evaluation/Cost Analysis for the Upper Reach of the Housatonic River (07-0030) evaluating remediation alternatives for the EE/CA Reach was submitted to the U.S. Army Corps of Engineers, North Atlantic Division, New England District (CENAE) and to the U.S. Environmental Protection Agency (EPA) on 11 February 2000. The findings of the EE/CA were presented at the Citizens' Coordinating Council meeting in Pittsfield on 1 March 2000. Based on the findings of the Final Draft EE/CA Report and identified data gaps, additional investigation activities within the EE/CA Reach have been conducted. The proposed activities are described in the Supplemental Work Plan (07-0032). The EE/CA Report was finalized with the completion and distribution of Section 6 of the report, Recommended Alternative, on 17 July 2000.

1.1 SITE BACKGROUND

The Combined Action and EE/CA Approval Memorandum (00-0158) identifies four sections within the upper 2 miles of the Housatonic River Upper Reach Removal Site: Newell Street to Lyman Street (approximately 0.5 mile), Lyman Street to Elm Street (0.5 mile), Elm Street to Dawes Avenue (approximately 0.4 mile), and Dawes Avenue to the confluence of the East and West Branches of the Housatonic River (approximately 0.6 mile). The Newell Street to Lyman Street section (the Upper ½ Mile Reach) is the subject of a separate Removal Action currently in progress as Phase I of the Combined Action. Under Phase II, the EE/CA addresses the remaining three sections of the Upper Reach. The EE/CA Reach has been divided into 11 subreaches based on physical characteristics. Figure 1-2 depicts these subreaches. As shown in the figure, Subreaches 3-8, 3-9, and 3-10 span the portion of the site from Lyman Street to Elm Street; Subreaches 4-1, 4-2, and 4-3 span the portion of the site from Elm Street to Dawes Avenue (also referred to as the "cobble reach"); and Subreaches 4-4A, 4-4B, 4-5A, 4-5B, and 4-6 span the portion of the site from Dawes Avenue to the confluence.

The focus of the EE/CA is contamination in the river sediments and riverbanks. Both the Upper ½ Mile Reach of the river and the EE/CA Reach include other potential sources of contamination. Additional source control, including control of nonaqueous phase liquid (NAPL) contamination in the Upper ½ Mile Reach identified in the Combined Action and EE/CA Approval Memorandum (00-0158), will be addressed as part of source control for the Upper ½ Mile Reach.

Section 2 of the Final Draft EE/CA (07-0030) provides a detailed background description of the EE/CA Reach, as well as a summary and analysis of the riverbank soil and sediment analytical data obtained from the EE/CA Reach in 1998 and 1999. The following paragraphs briefly describe the results of previous soil and sediment sampling in the EE/CA Reach and the resulting conclusions regarding the source, nature, and extent of contamination.

In 1998 and 1999, an extensive riverbank soil and sediment sampling program was conducted within the EE/CA Reach and adjacent portions of the Housatonic River. Riverbank soil and sediment samples were collected along transects perpendicular to the river and spaced every 100 ft. For banks, sampling locations were obtained at the bottom of bank (water's edge), midbank, and top of bank. Riverbank soil samples were collected perpendicular to the bank slope at depths of 0 to 0.5, 1 to 1.5, and 2 to 2.5 ft and analyzed for PCBs. Ten percent of the samples were also analyzed for Appendix IX constituents. Sediment samples were obtained along each transect in the EE/CA Reach at three approximately equidistant points within the river channel (right side, midchannel, and left side). Sediment samples were collected at 0.5-ft intervals to a depth of 3 ft. Additional samples were collected at selected locations to the maximum depth obtainable with manual equipment. All sediment samples were analyzed for PCBs and total organic carbon (TOC). Ten percent of the sediment samples were also analyzed for Appendix IX parameters.

The detailed summary and tabulation of the analytical results of the sampling described above is provided in the Final Draft EE/CA (07-0030). In general, the PCB concentrations in sediment showed a downward trend with depth, with the average PCB concentration in the 3- to 4-ft depth interval approaching 1 ppm. Appendix IX constituents, particularly certain PAHs, were found in the shallow sediment in some locations. One location had exceedances of applicable Appendix IX cleanup criteria at the deepest sampling depth.

PCB and Appendix IX constituent results for the riverbanks showed no distinct trend with depth. In general, there were many locations where PCB cleanup criteria were exceeded at the deepest depth sampled (2 to 2.5 ft).

In addition to the sediment and bank soil sampling, cobble test plots were installed in the Cobble Reach. The cobble test plots were installed to obtain information on the relative percentage of cobbles and finer material in the river channel in the Cobble Reach, and to assess the level of contamination on the cobbles and in the finer material. During installation of the cobble test plots, NAPL was observed at several locations in the river in the Cobble Reach. Evidence of NAPL was observed both in the cobble test plots themselves and as separate phase product on the riverbed. Supplemental historical information indicated that a former Berkshire Gas facility had been operated south of Elm Street along Deming Street adjacent to the river. Analysis of the NAPL observed during the Cobble Reach sampling confirmed that the material was coal tar.

Eight borings were installed along the tops of the riverbanks along the EE/CA Reach for the purpose of obtaining geotechnical data. The geotechnical data obtained from the borings provided an initial indication of the physical characteristics of the riverbank soils and location of bedrock along the EE/CA Reach.

1.2 OBJECTIVE

The purpose of the additional investigation conducted at the EE/CA Reach was to collect data to further assess potential NAPL sources, obtain additional geotechnical data, and assess contamination in banks and sediments at depth. The main objectives of the investigation were as follows:

- Assess the nature and extent of NAPL in sediment and riverbank soils in the EE/CA Reach, targeting areas where NAPL has been previously observed or is suspected based on historical land use. The presence of NAPL in these media has the potential to significantly disrupt construction activities.
- Further assess the nature and extent of PCBs and Appendix IX constituents in riverbank soils and sediment in selected areas, to confirm the excavation volumes presented in the Final Draft EE/CA Report.
- Further evaluate soil and sediment geotechnical parameters that may affect the selection of response actions and/or design parameter values for bank stability, sheetpile depth, and restoration method.
- Assess groundwater quality and flux into the river to determine if a sorptive cap is necessary in the bank backfill and to facilitate design of the dewatering treatment system.

Consistent with the recommendations for additional data collection provided in the Final Draft EE/CA Report, and based on the data and objectives described above, the following specific areas were identified for additional investigation:

- Assessment of the nature and extent of potential NAPL impacting the river in the vicinity of former Oxbows A, B, and C, downstream of Lyman Street.
- Assessment of the extent of coal tar NAPL in the Cobble Reach, where evidence of this material was observed during the 1999 sampling.
- Assessment of PCBs and Appendix IX constituent concentrations in deeper sediment (3 to 6 ft) associated with aggrading bar facies.
- Assessment of Appendix IX constituent concentrations in deeper sediments at locations where the existing results exceeded cleanup goals at depth.

- Assessment of PCB constituent concentrations in riverbank soils at greater depths (3 to 6 ft) on nonresidential properties.

- Assessment of PCB constituent concentrations in riverbank soils in previously unaccessed areas (adjacent to Harry's Supermarket).

- Further assessment of geotechnical characteristics of riverbank soils and sediment/soil beneath the river channel.

- Assessment of groundwater flux into the river, along with assessment of groundwater contaminant levels using seepage meters.

1.3 SCOPE OF WORK

The Scope of Work presented in this section was developed to address the objectives stated in Subsection 1.2. The Scope of Work was divided into the following investigations:

- NAPL Investigation—The NAPL investigation focused on assessing the potential for NAPL related to the former oxbows in Subreaches 3-8, 3-9, and 3-10, and evaluating the extent of NAPL observed in the reach between Elm Street and Dawes Avenue during previous investigations.

- Sediment Sampling—Sediment sampling was conducted to address data gaps regarding the distribution of PCBs at depth in the aggrading bars and within the 1- to 3-ft depth interval in Subreach 4-4A, as well as Appendix IX exceedances at depth in selected locations.

- Riverbank Soil Sampling—Riverbank soil sampling was conducted to assess the extent of PCBs at depth on nonresidential properties and in previously unsampled areas (adjacent to Harry's Supermarket).

- Geotechnical Investigation—The geotechnical investigation focused on gathering additional soils data from both the riverbanks and soils underlying the riverbed.

- Pore Water Assessment—The pore water assessment used seepage meters to assess the quality and quantity of groundwater entering the river and to determine if a sorptive cap is necessary in the bank backfill.

The planned investigations and associated tasks are summarized in Table 1.3-1.

A Supplemental Work Plan (07-0032) was prepared that described all the planned additional investigations and provided maps showing the proposed locations of all field activities.

Section 2
Supplemental Site Characterization

2. SUPPLEMENTAL SITE CHARACTERIZATION

This section describes the field investigation activities conducted as part of this investigation and discusses the analytical results and engineering data.

2.1 FIELD INVESTIGATION

This subsection briefly describes the sampling procedures and locations, the sampling rationale, and the analyses performed.

2.1.1 NAPL

The NAPL investigation included two components: assessment of the nature and extent of the NAPL found in the Cobble Reach during the initial EE/CA investigation in 1999, and an assessment of the potential for NAPL associated with the former oxbows in the upper portion of the EE/CA Reach between the Lyman and Elm Street bridges.

2.1.1.1 Oxbow NAPL Investigation

A total of 52 soil borings (see Figure 2.1-1) were advanced along the base of the riverbank to evaluate the presence of nonaqueous phase liquids (NAPL) in the vicinity of the former oxbows. The work was conducted between 13 June and 21 July 2000. The borings were advanced approximately 50 ft apart along banks where former oxbow areas are located in the portion of the river between the Lyman and Elm Street bridges. Because of the steep slope of the bank in this area, the drilling equipment used for this effort was placed on a barge and moved up and down the river to access the specific locations.

The borings were advanced to a depth of approximately 10 ft below the river bottom using Geoprobe® Systems direct-push drilling methodology. Two drilling subcontractors were used to complete the work in order to meet the aggressive schedule. Geo Logic, Inc., of Hopkinton, MA, and GeoTek Engineering, Inc., of Framingham, MA, were used to supply and operate the Geoprobe rig and barge. Sediment samples were collected continually from the base of the riverbank to the bottom of the borehole using 4-ft-long Geoprobe macrosampler tubes. Upon removal from the borehole, each sample was screened in the field for VOCs using photoionization detector (PID) headspace analysis. The PID readings, lithology, and pertinent features such as odors and/or staining were recorded by the geologist in the field logbook. Boring logs are included in Appendix A.

The samples were initially screened visually for potential NAPL and subsequently screened for NAPL using Sudan IV dye. Jar shake tests were also conducted on samples as an additional NAPL screening method.

Based on the results of the dye tests and visual observations for potential NAPL, a total of 25 soil boring locations were completed as piezometers (Figure 2.1-1). The piezometers were constructed of 1-inch-diameter, Schedule 40 PVC riser, and approximately 2 ft of 1-inch-diameter, 10-slot well screen. An approximate 2-ft stickup was left at each piezometer location. Upon completion, each piezometer was purged of approximately 10 standing water volumes on three separate occasions in an effort to recover potential NAPL. Free-flowing NAPL was not encountered in any of the piezometers, so no NAPL samples were collected.

2.1.1.2 Cobble Reach NAPL Investigation

Results of the Cobble Reach “test plot” excavations performed in June 1999 indicated the presence of NAPL along the west bank of the river in the “cobble reach” between Elm Street and Dawes Avenue. This investigation was conducted to supplement the initial findings and further delineate the extent of NAPL.

A total of 20 new “test plots” were excavated from just upstream of the Elm Street Bridge (transect T104) to just below Subreach 4-4A (transect T158) between 31 May and 19 June 2000. The locations of the test plots are shown in Figure 2.1-1. The test plots encompassed a 3-ft by 3-ft area that was defined in the field using a bottomless “box” created by nailing pieces of 2-ft by 12-inch dimensional lumber together. Once installed, sand, gravel, and cobbles were manually removed from the test plot and placed adjacent to the excavation until the maximum practical excavation depth was reached (approximately 1 to 2 ft down). Observations regarding the presence of sheens, potential NAPL, and coal tar were made. Based on these observations, sediment was selected for a Sudan IV dye test. The dye changes color if NAPL is present in the sample. Results of the test were recorded (positive or negative). One sediment sample containing NAPL was collected and analyzed for PCBs and Appendix IX parameters.

If potential NAPL was encountered, a piezometer was installed in order to allow subsequent monitoring for NAPL. A total of six piezometers were installed in the Cobble Reach. The piezometers were constructed of 1-inch-diameter, Schedule 40 PVC riser, and approximately 2 ft of 1-inch-diameter, 10-slot well screen. An approximate 2-ft stickup was left at each piezometer location. Upon completion, each piezometer was purged of approximately 10 standing water volumes on three separate occasions in an effort to recover NAPL.

2.1.2 Sediment

The supplemental sediment sampling program consisted of two major components: sampling of aggrading bars and terraces to assess the depth of PCB contamination associated with these structures; and sampling of deeper sediment in the Subreach 4-4A area where previous manual sampling was unsuccessful due to the presence of cobbles.

2.1.2.1 Aggrading Bars and Terraces

Sampling of aggrading bars and terraces was conducted to characterize potentially contaminated sediments that are exposed during low-flow conditions. As defined by the USGS (02-0089), terrace deposits occur in parts of the riverbed that are usually inundated during high-flow conditions, but are exposed during low-to-moderate flows. Aggrading bar deposits, or small islands or mounds, are typically composed of coarse-grained material (i.e., sands and gravels) and usually occur along the inner sides of channel curves. A total of 10 aggrading bars meeting these criteria were identified within the EE/CA Reach, mostly downstream of the Elm Street Bridge.

Two borings were drilled at each terrace/aggrading bar. Locations are shown in Figure 2.1-2. One of the borings was advanced at the portion of the bar or terrace that represents the maximum depth of accumulated sediment. The second boring was advanced at a location equidistant from the first boring and the farthest end of the bar or terrace. The soil borings were advanced using a barge-mounted Geoprobe® Systems direct-push drilling rig that was owned and operated by

GeoTek Engineering Inc., of Framingham, MA. The work was conducted from 28 June through 13 July 2000. Sediment samples were collected continually from the surface of the aggrading bar to the bottom of each borehole using 4-ft-long Geoprobe macrosamplers. Upon removal from the borehole, each sample was screened in the field for VOCs using PID headspace analysis. The PID readings, and any pertinent features such as odors and/or staining, were recorded by the geologist in the field logbook. Boring logs are included in Appendix A.

The borings were advanced to a maximum depth of 6 ft below ground surface (bgs) or until refusal, whichever occurred first. The sediment cores were then divided into 6-inch sections, starting with the first interval occurring below the depths proposed for excavation in the Final Draft EE/CA Report, typically 2 to 3 ft bgs (07-0030). Each section was analyzed for PCBs (total), grain size, and TOC. Some 24 cores were collected with a total of 110 samples analyzed. Approximately 10% of the samples were analyzed for the modified Appendix IX parameters. Approximately 2% of these samples (every fifth Appendix IX sample) were analyzed for Appendix IX organophosphate pesticides and herbicides.

2.1.2.2 Deeper Sediment Sampling

Deeper sediment sampling was conducted to fill data gaps relative to the 2- to 3-ft-depth interval in Subreach 4-4A and at locations where there were previous Appendix IX parameter exceedances at depth. Sediment sample locations are shown in Figure 2.1-2.

Location SD021802 was resampled for Appendix IX parameters based on previous exceedances. The sample, identified as SE001345 in Figure 2.1-2, was collected from the 4- to 4.5-ft depth interval on 7 July 2000 using a barge-mounted Geoprobe rig owned and operated by GeoTek Engineering, Inc., of Framingham, MA.

A total of seven samples were collected from the 2- to 3-ft depth interval in Subreach 4-4A to supplement previous sampling efforts in this area. The sample locations consisted of SD021521, SD021522, SD021523, SD021541, SD021542, SD021543, and SD021561. The samples were collected on 19 and 20 July 2000 using a barge-mounted geoprobe rig owned and operated by GeoTek Engineering, Inc., of Framingham, MA.

2.1.3 Riverbank Soils

Supplemental sampling of riverbank soils included three components: deeper sampling at locations with previous exceedances of Appendix IX screening criteria; deeper sampling on all nonresidential properties; and sampling in previously unaccessed areas.

2.1.3.1 Deeper Riverbank Sampling at Appendix IX Exceedances

Soil samples were collected at riverbank transects that previously had an Appendix IX exceedance. A total of seven locations were targeted for sampling; however, refusal was encountered at three of the locations before the target depth (4 to 4.5 ft) was reached. Thus, a total of only four samples were collected for laboratory analysis. Sampling was conducted by WESTON personnel between 31 May and 27 June 2000. Sample locations are shown in Figure 2.1-3. The samples were collected from the middle of the bank and analyzed for Appendix IX parameters, TOC, and grain size. Two of the four samples were also analyzed for the Appendix IX organophosphate pesticides and herbicides.

2.1.3.2 Deeper Riverbank Sampling at Nonresidential Properties

In order to assess the levels of PCBs at depths greater than 3 ft that were not previously sampled, soil samples were collected from the middle bank location at nonresidential riverbank transects. Eighty-five middle-bank borings were planned, but refusal was encountered at 26 locations before the target depth-interval was reached. Thus, a total of 59 locations were advanced to at least the shallowest target sampling depth and samples were collected for analysis. Samples were collected from the 3- to 3.5-ft, 4- to 4.5-ft, and 5- to 5.5-ft depth intervals. Sampling was conducted by WESTON personnel between 25 May and 14 July 2000. The locations of the samples are shown in Figure 2.1-3. Each sample was analyzed for PCBs and 10% of the samples were also analyzed for TOC and grain size.

2.1.3.3 Riverbank Soils Sampling at Previously Unaccessed Areas

During previous sampling efforts for the 1½-Mile EE/CA Reach, WESTON was unable to sample the riverbank soils in selected areas due to property-owner access restrictions. These areas include the west bank just north of the Elm Street Bridge, and a short section of the east bank across from Fred Garner Park just above the confluence. Riverbank soil samples were collected from these two areas at the predefined transects. Sampling locations at each transect included the following:

- Bottom of bank (water's edge).
- Midbank.
- Top of bank.

Samples were collected from hand-auger borings drilled perpendicular to the slope of the riverbank at depths of 0 to 6, 12 to 18, and 24 to 30 inches. All samples were analyzed for PCBs. In addition, 10% of the samples were also analyzed for Appendix IX SVOCs, organochlorine pesticides, dioxins, furans, inorganics, grain size, and TOC. Two percent of all samples (every fifth Appendix IX sample collected) were analyzed for Appendix IX organophosphate pesticides and herbicides. Sampling was conducted by WESTON personnel between 15 June and 21 June 2000. Sample locations are shown in Figure 2.1-3.

2.1.4 Geotechnical

The geotechnical investigation consisted of two components: borings drilled along the top of the riverbank using a truck-mounted drilling rig; and borings drilled through the riverbed using a barge-mounted drilling rig.

2.1.4.1 Riverbank Geotechnical Borings

A total of 31 soil borings were drilled along the tops of the riverbank for the purpose of collecting geotechnical information. The borings were spaced approximately 500 ft apart along the river (alternating between banks) and were drilled to a depth of 20 ft below the riverbed, or refusal, whichever was less. Locations of the borings are shown in Figure 2.1-4.

The soil borings were drilled using a truck-mounted drilling rig owned and operated by GeoTek Engineering, Inc., of Framingham, MA. The work was conducted between 1 June and 13 July 2000. Hollow-stem auger and case and wash drilling methods were used as appropriate, depending on site conditions, to advance the borings to the prescribed depth. Soil samples were collected at 5-ft intervals until the elevation of the riverbed was reached and at 10-ft intervals thereafter. The samples were collected using a 2-ft-long split-spoon sampler following Standard Penetration Test (SPT) procedures. Each sample was submitted for grain size, moisture content, Atterberg limits, organic content, and specific gravity analyses. In addition, the 8- to 10-ft soil sample from boring BH-000116 was observed to contain black, oily material and was submitted for PCB analysis.

Monitor wells were installed in two of the borings based on observations of oily/stained soils. The monitor wells were constructed of 2-inch-diameter, Schedule 40, flush-threaded PVC riser and 10 ft of 0.010-slotted PVC well screen. The annulus was backfilled with #0 Morie sand to a level 2 ft above the top of the screen. A 2-ft-thick bentonite seal was installed above the sand pack. The remainder of the annulus was filled with a cement-bentonite grout. NAPL was not observed in either of the two monitor wells. Logs for the borings and well completion diagrams for the monitor wells are included in Appendix A.

2.1.4.2 Riverbed Geotechnical Borings

A total of 13 shallow soil borings were drilled in the middle of the river for the purpose of collecting geotechnical information from below the riverbed. The borings were drilled using a barge-mounted drilling rig owned and operated by GeoTek Engineering, Inc., of Framingham, MA, between 15 June and 13 July 2000. The borings were spaced approximately 500 ft apart (except for the Cobble Reach) and were drilled to a depth of about 20 ft below the river bottom. Locations of the borings are shown in Figure 2.1-4.

Soil samples were collected at 5-ft intervals using a 2-ft-long split-spoon sampler and SPT procedures. Upon removal from the borehole, each sample was screened in the field for VOCs using PID headspace analysis. Each sample was analyzed for grain size, moisture content, Atterberg limits, organic content, and specific gravity. Logs for the borings are included in Appendix A.

2.1.5 Pore Water

A total of nine seepage meters were installed in order to collect sediment pore water samples. Ten locations were planned but location SM-04 could not be installed because of abundant cobbles in that area. The seepage meters were installed at locations on both sides of the river, spaced evenly throughout the EE/CA Reach. The locations are shown in Figure 2.1-5. The seepage meters were installed by WESTON personnel between 29 June and 10 July 2000.

The seepage meters were constructed from new 55-gallon drums fitted with brass nipples. They were pushed into the sediment until the top of the seepage meter was approximately 1 to 2 inches above the sediment. Once installed, the seepage meters were allowed to equilibrate to the natural pore water flow conditions for a period of at least 48 hours. Pore water flux was measured by installing a deflated polyethylene bag on the brass nipple for a known time period and measuring the accumulated volume of water. Samples of the pore water were collected using the same procedure. The pore water samples were analyzed for VOCs, SVOCs, Appendix IX metals (including mercury), cyanide, sulfide, hardness, alkalinity, and PCBs.

2.2 ANALYTICAL DATA

This subsection presents the results of the various analytical testing conducted as part of this investigation. Summary tables of the data are included in each subsection. The complete analytical data set is included in Appendix B.

2.2.1 NAPL

NAPL investigations were conducted in two areas: the Cobble Reach to assess the extent of observed coal tar, and near the former oxbows to assess the potential for NAPL containing PCBs to exist there. The results of the investigations in these areas are discussed below.

2.2.1.1 Oxbow NAPL Investigation

A total of 52 soil borings were drilled along the riverbanks in areas where the former oxbows abut the river. Of the 52 soil borings, approximately 25 were completed as piezometers to assess the possible presence of free-flowing NAPL. The locations of the NAPL borings and piezometers are shown in Figure 2.1-1. The results of the NAPL field screening and visual observations of NAPL are summarized in Table 2.2-1. Observations for the 25 piezometers are summarized in Table 2.2-2.

Indications of potential NAPL were observed in approximately 13 of the 52 soil borings based on visual and olfactory observations and the results of the jar shake tests. Observations that potential NAPL may have been present in selected samples included a strong hydrocarbon odor, black staining of the soil, a hydrocarbon sheen, and free NAPL buildup on the sides of the shake test jar. Although a slight sheen was observed on the water purged from several of the piezometers, no free-flowing NAPL was encountered in any sample and therefore no analytical testing of NAPL was performed.

2.2.1.2 Cobble Reach NAPL Investigation

A total of 20 cobble test plots were excavated in the Cobble Reach to assess the extent of coal tar-type NAPL observed during previous investigations. In addition, six piezometers were installed to assess the presence of free-flowing NAPL and obtain samples for analysis. The locations of the NAPL borings and piezometers are shown in Figure 2.1-1. The results of the Cobble Reach NAPL field screening and visual observations of NAPL are summarized in Table 2.2-3. Observations for the six piezometers are summarized in Table 2.2-4.

Indications of potential NAPL were observed in approximately 16 of the 20 test plots based on visual and olfactory observations and the results of the Sudan IV dye tests. Observations that potential NAPL may have been present in selected samples included a strong coal tar odor, black staining of the soil, a hydrocarbon sheen, and bright red staining as a result of the Sudan IV dye. Flowing NAPL was identified in four of the test plots. Free-flowing NAPL was encountered in PZ-05 but was too viscous to allow sample collection. A sample of sediment containing the NAPL was collected and submitted for Appendix IX analysis. The results of this analysis are summarized in Table 2.2-5. The complete laboratory report is included in Table B-5 in Appendix B. The results show that the sample contained levels of semivolatile organic compounds (SVOCs) and metals in excess of Ontario Ministry of the Environment and Energy (OMEE) Severe Effect Level (SEL) values. The total PCB concentration was 5.4 mg/kg. These results are suggestive of a coal tar source possibly associated with the former Berkshire Gas facility.

2.2.2 Sediment

Sediment samples collected from aggrading bars and Subreach 4-4A were analyzed for PCBs. Additional samples were collected from areas with Appendix IX exceedances and were analyzed for Appendix IX constituents. The results are presented below by sample type.

2.2.2.1 Aggrading Bars and Terraces

A total of 110 samples were collected from the aggrading bars to assess the potential for PCBs to exceed cleanup goals with depth. The locations of the samples are shown in Figure 2.1-2. The results of the aggrading bar sampling are summarized in Table 2.2-6. The complete data set is presented in Table B-1 of Appendix B. The results indicate that concentrations of PCBs exceeding the sediment cleanup goal by more than an order of magnitude exist at depths up to 6 ft (the deepest interval sampled). More than three quarters of the samples collected (81%) exceeded the cleanup goal of 1 ppm (PCBs).

2.2.2.2 Deeper Sediment Sampling

Supplemental sediment samples were collected from Subreach 4-4A to provide additional characterization of the 2- to 3-ft depth interval. A total of seven samples were collected and analyzed for PCBs. The locations of the samples are shown in Figure 2.1-2 and the analytical results are summarized in Table 2.2-7. The concentration of PCBs in all seven samples obtained from within the 2- to 3-ft depth interval exceeds the cleanup goal of 1 ppm. The average PCB concentration for this interval is 11.7 ppm and the 95% UCL of the average concentration is 26.6 ppm. These data indicate that all of the sediment in the 2- to 3-ft depth interval in Subreach 4-4A will require removal. This is consistent with the assumptions made in the Final Draft EE/CA, which were based on more limited data.

One sample (SE001345) was collected from a location where previous sampling had indicated exceedances of screening criteria for Appendix IX constituents. An additional 11 samples were also analyzed for Appendix IX constituents in accordance with the 1-in-10 protocol described in the SAP. The results of the Appendix IX analyses are presented in Table B-2 in Appendix B. The results were compared to Massachusetts Contingency Plan (MCP) S-2 Soil Standards, OMEE

Lowest Effect Level (LEL), and SEL values on a sample-by-sample basis. The comparison to standards is presented in Table B-7 of Appendix B. The comparison indicates that numerous SVOCs and selected metals (copper, lead, and to a lesser extent mercury and nickel) are present at levels exceeding the MCP S-2 and OMEE LEL values. The majority of the samples were collected from the 3- to 6-ft depth within the aggrading bars. Only location SE001345 was not co-located with elevated PCB concentrations that will be removed. Sample SE001345 exhibited exceedances of the OMEE LEL values but not the MCP S-2 or OMEE SEL values, suggesting the concentrations of these compounds are likely not at toxic levels.

2.2.3 Riverbank Soils

Sampling of riverbank soils was conducted to assess PCB concentrations at depth on nonresidential properties and on previously unaccessed properties, and Appendix IX constituent concentrations at depth in areas where previous sampling indicated exceedances in the deepest samples.

2.2.3.1 Deeper Riverbank Sampling at Appendix IX Exceedances

Four samples were collected from locations where previous sampling had indicated exceedances of screening criteria for Appendix IX constituents. The locations of the Appendix IX samples are shown in Figure 2.1-3. An additional 17 samples were also analyzed for Appendix IX constituents in accordance with the 1-in-10 protocol described in the SAP. The results of the Appendix IX analyses are presented in Table B-4 in Appendix B.

The Appendix IX data were evaluated in the same manner as that described in the Draft Final EE/CA Report and included comparison to EPA Region IX Preliminary Remediation Goals (PRGs), background concentrations, and MCP S-2 soil cleanup standards. The results of the comparison are summarized in Table B-8 in Appendix B. The comparison shows that only 3 of the 21 total samples failed the comparison to standards. The three locations are RB011041, RB021945, and RB021965. The sample at location RB011041 was collected from a depth of 0.0 to 0.5 ft and will be removed as part of the PCB excavation. Locations RB021945 and RB021965 were collected from a depth of 4.0 to 4.5 ft and are not currently within an area that is targeted for removal.

2.2.3.2 Deeper Riverbank Sampling at Nonresidential Properties

Samples were collected from depths greater than 3 ft at each nonresidential property along the EE/CA Reach to assess the PCB concentrations in riverbank soils at depth. Refusal was encountered at 26 locations before the target depth could be reached. A total of 59 locations were sampled, with 187 samples collected and analyzed for PCBs. The locations of the samples are shown in Figure 2.1-3. The complete sample results are included in Table B-3 in Appendix B.

The results are summarized in Table 2.2-8 by depth interval. Previous results from the shallower depths have been included for comparative purposes. The results indicate that there is little to no reduction in PCB concentrations with depth until the 5- to 5.5-ft interval is reached.

2.2.3.3 Riverbank Soils Sampling at Previously Unaccessed Areas

A total of 96 riverbank soil samples were collected from areas that had not been sampled previously due to property-owner access restrictions. These areas include the west bank just north of the Elm Street Bridge, and a short section of the east bank across from Fred Garner Park. The locations of the samples are shown in Figure 2.1-3. The complete sample results are included in Table B-3 in Appendix B.

The results of the PCB analysis for the two areas are summarized in Table 2.2-9. The results are generally consistent with those reported for nearby areas in the Final Draft EE/CA Report and will not require removal of any additional material. These areas had previously been targeted for complete removal to 3 ft.

2.2.4 Pore Water

Nine seepage meters were installed to obtain samples of the pore water that discharges to the Housatonic River. The locations of the seepage meters are shown in Figure 2.1-5. Table 2.2-10 summarizes the results of the pore water analysis. The complete laboratory results are included in Table B-6 in Appendix B.

The water quality results were compared to MCP GW-3 groundwater standards and to the NPDES discharge criteria. Only PCBs exceeded the GW-3 standards and that is likely the result of the groundwater passing upward through the contaminated sediments that will be removed. Thus, continuing discharge of groundwater into the river after the remedial action has been completed is not believed to be a concern.

In addition to PCBs, thallium and zinc exceeded the NPDES discharge criteria and thus will require treatment prior to discharge during dewatering activities in support of the remedial action.

2.3 ENGINEERING DATA

The engineering data developed during this investigation includes the results of geotechnical testing performed on soil samples collected from borings drilled in the riverbed and on the top of bank along the EE/CA Reach, and flux estimates of groundwater discharge into the river that were obtained from the seepage meters.

2.3.1 Geotechnical Data

A total of 44 geotechnical borings were drilled to characterize subsurface conditions along the length of the EE/CA Reach. Thirty-one of the 44 borings were drilled along the top of the bank and the remainder were drilled through the riverbed using a barge-mounted rig. Geologic logs for the borings are included in Appendix A. Locations of the borings are shown in Figure 2.1-4. Selected samples were submitted to a materials-testing laboratory for grain size, moisture content, Atterberg limits, organic content, and specific gravity analyses.

The results of the geotechnical analyses are included in Appendix C.

The result of the PCB analysis conducted on the 8- to 10-ft sample from boring BH-000116 indicated a total PCB concentration of 204 mg/kg, suggesting that there may be substantial PCB contamination at depth in this area.

2.3.2 Groundwater Discharge Estimates

Nine seepage meters were installed at roughly equal distances along the EE/CA Reach to evaluate the quantity and quality of the groundwater that discharges to the river (pore water).

Seepage meter locations are shown in Figure 2.1-5. The pore water flux rate was measured by installing a polyethylene bag on each seepage meter. The bags were collected after about 24 hours and the accumulated volume of pore water was measured and the time recorded. The total volume was divided by the time interval to get a volume-per-unit-time estimate that was subsequently normalized using the area of the seepage meter. The resulting unit seepage (groundwater flux) rates are summarized in Table 2.2-11. The groundwater flux rates varied from 0.1 gallons per day per square ft (gpd/ft^2) to 1.1 gpd/ft^2 with an average rate of 0.5 gpd/ft^2.

Section 3
Findings and Conclusions

3. FINDINGS AND CONCLUSIONS

This section describes findings and conclusions regarding impacts on the removal action based on the available new data. The following subsections describe findings regarding excavation volume changes, impacts of the presence of NAPL, groundwater discharge into the river, and overall removal action costs.

3.1 EXCAVATION VOLUME CHANGES

Excavation volumes were reassessed based upon the newly acquired data. Field laboratory PCB results were used in this evaluation. For the riverbanks, results were consistent with past results, indicating no changes to bank soil excavation volumes. For sediments, the aggrading bar sampling in Subreaches 4-4B, 4-5A, 4-5B, and 4-6 indicates PCBs exceed the 1-ppm cleanup level below the previously assumed excavation depths. Based on this sediment excavation, volume has increased by approximately 1,834 yd^3. The total volume of sediments and soils requiring removal is estimated at 95,375 yd^3 (45,128 yd^3 for sediments and 50,247 yd^3 for bank soils). As described in Chapter 6 of the EE/CA, this volume includes approximately 3,740 yd^3 of riverbank soils at residential locations to account for increased excavation depths necessary to meet the revised cleanup criterion at residential property locations.

The newly acquired Appendix IX results for bank soils and sediment did not indicate the need for changes to current excavation volumes. Although exceedances of comparison criteria were noted in Appendix IX results for a number of deeper aggrading bar samples, these were co-located with PCB exceedances and this sediment is to be removed. The results of the additional Appendix IX analytical work are summarized in Section 2.

3.2 POTENTIAL OTHER IMPACTS

3.2.1 Oxbow Investigation

Evidence of NAPL was observed in 4 of the 20 piezometers; however, NAPL volumes sufficient to collect samples were not encountered. These results suggest no significant impacts to technology selection for river diversion and sediment removal in the reach of river between

Lyman Street and Elm Street. However, the potential exists for encountering isolated pockets of NAPL rather than widespread areas of NAPL in the Oxbow areas.

3.2.2 Cobble Reach NAPL Investigation

Indications of NAPL were found in 16 of 20 test plots, and free-flowing NAPL was found in four of the test plots. Therefore, it is anticipated that additional measures will be required to control the migration of NAPL in the Cobble Reach during excavation activities. In addition, collection of free-phase NAPL during excavation will result in the need for proper disposal of this material. Furthermore, the disposal of any DNAPL-impacted sediments (as opposed to free-phase DNAPL) may have to be reevaluated. Based on the number of coal tar constituents present in the sediments, alternate disposal methods from those presented in the EE/CA may be required. Analytical results for the NAPL samples collected confirm previous results, indicating that the NAPL observed in this area is likely a coal tar residue, and does not contain any appreciable levels of PCBs.

3.2.3 Aggrading Bars and Terraces

Based on the PCB concentrations above the 1-ppm cleanup guideline at depth (3 to 6 ft) in the aggrading bars, excavation and removal of sediment within the aggrading bar areas has been determined to be necessary. For the purposes of estimating the additional excavation volume associated with the aggrading bars, an average aggrading bar size has been estimated (50 ft by 20 ft; 1.5:1 sideslope), and additional excavation volumes calculated accordingly. The excavation and removal of this material increases the total removal volume by 1,834 yd^3. The calculation is provided in Table 3.2-1.

As a result of the changes, the depth of excavation has increased to 6 ft in the areas associated with the aggrading bars and terraces. These increased depths have the potential for requiring a different sheetpile embedment depth and section modulus. In addition, these excavation depths could affect the required riverbed dewatering rates.

3.2.4 Groundwater Discharge Estimates and Pore Water Analytical Results

The calculated groundwater discharge estimates based on the seepage meter data (see Section 2) are considered consistent with the flow rates used in the Final EE/CA Report (07-0083) for estimating dewatering volumes. Therefore, no changes to the estimated flow rates are recommended.

The analytical results for the pore water samples are described in Section 2. These results were evaluated, and do not suggest the need for any changes in the selection of water treatment technologies for water resulting from dewatering during construction.

At seven of the nine seepage meter locations, PCBs were not detected above the MCP GW-3 criterion of 0.5 µg/L. Therefore, a sorptive cap for the lower banks was not considered further at these locations. For the remaining two locations, it is likely that the exceedances are caused by groundwater passing through contaminated sediments. These sediments will be removed during the removal action; therefore, backfill materials containing sorptive materials other than that which is naturally occurring are not considered necessary at these locations in the lower banks. Overall, the seepage meter data do not support the need for a sorptive cap in the lower banks at any location in the 1 ½ Mile Reach.

3.3 COST ESTIMATE

The estimated costs (note these are all present worth costs) for the three base alternatives and the recommended alternative presented in the Final Draft EE/CA (17 July 2000) were reevaluated based on the following factors:

- Additional sediment excavation volume of 1,834 yd^3 that will be required to address PCBs in the aggrading bars (see Table 3.2-1 for estimate).
- The productivity of the excavation and restoration can be impacted by poor weather or unforeseen conditions such as encountering NAPL. Evidence of the impact of weather and the presence of NAPL on a dry excavation scenario using sheetpile diversion has been observed in the Upper ½ Mile Reach of the Housatonic River currently undergoing excavation by GE and its contractors. Heavy rains have resulted in the overtopping of the sheetpile walls on two occasions. The presence of NAPL has had an even greater effect, causing temporary work stoppages and/or slowdowns on multiple occasions. Based on the evidence in the Upper ½ Mile Reach, and the

potential for adverse weather conditions and encountering NAPL during the 1 ½ Mile Reach removal action, the assumed overall productivity rates for the purpose of cost estimation have been reduced by 50%. This increases the project duration used in the cost estimate to 4 years.

- Experience gained while observing the current removal activity in the Upper ½ Mile Reach indicates that longer sheetpiling may be necessary to reduce the potential for overtopping the sheetpile cells. This is based on the fact that there have been two overtopping events in the Upper ½ Mile Reach, the effects of which could have been minimized with longer sheets reaching a higher elevation. In addition, the necessity for deeper excavation in several areas to address PCB concentrations associated with aggrading bars will require deeper sheetpile placement and longer sheetpile lengths in these areas. The length of the sheetpiling is therefore increased to 28 ft for project cost estimating purposes.

- Contractor markups, contingency, engineering and design, and USACE Construction Management percentages are unchanged from those used in the cost estimates for the three base alternatives and the recommended alternative.

The revised estimated costs for the three base alternatives in the EE/CA are as follows:

- Wet Excavation (Alternative 1)—$29.1 million
- Dry Excavation with Sheetpile/Pumped Bypass (Alternative 2)—$36.0 million
- Dry Excavation with Pumped Bypass (Alternative 3)—$31.5 million

When combined with the cost for Disposal Option A of $13.7 million, the total costs for the three alternatives are as follows:

- Alternative 1—$42.8 million (see Appendix D.1)
- Alternative 2—$49.7 million (see Appendix D.2)
- Alternative 3—$45.2 million (see Appendix D.3)

The total cost for the recommended alternative is $49.7 million. This cost includes a modified Base Alternative cost of $36.0 million (see Appendices E.1 through E.4) and Disposal Option A cost of $13.7 million (see Appendix E.5).

When compared to the costs presented in Section 6 of the Final Draft EE/CA Report (07-0083) for the recommended alternative, the revised costs represent an overall increase of $8.93 million. The Base Recommended Alternative cost rose by $8.39 million and the Option A disposal cost rose by $540,000. The revised cost estimate for the recommended alternative reflects the decreased excavation production rate described above (half of that presented in Section 6 of the

Final Draft EE/CA Report (07-0083)), the increased sediment excavation volume (by 1,834 yd^3) to account for the aggrading bars, and an increase in the length of sheetpile from 20 ft to 28 ft.

The effect on the estimated cost of the recommended alternative presented here and as presented in Section 6 of the Final Draft EE/CA Report (07-0083) from decreased excavation productivity, increased sheetpile length, and revised excavation volumes is presented in the following table.

Item	Contractor Cost (Millions)	Total Present Worth Cost (Millions)*
Base Removal Alternative (from Chapter 6 of EE/CA)	$ 19.29	$ 27.60
Decreased Excavation Productivity	$ 5.60	$ 8.02
Increased Excavation Volume	$ 0.08	$ 0.12
Increased Sheetpile Length	$ 0.17	$ 0.25
Subtotal	**$ 25.15**	**$ 35.99**
Disposal Option A (from Chapter 6 of EE/CA)	$ 9.18	$ 13.13
Increased Disposal Volume	$ 0.38	$ 0.54
Subtotal	**$ 9.55**	**$ 13.67**
Total	**$ 34.70**	**$ 49.66**

*This cost includes markups as follows: 25% contingency, 6% engineering and design, and 8% construction management.

Section 4
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4. REFERENCES

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